

**ODISHA POWER GENERATION COMPANY LIMITED  
2x660 MW IB TPP BANHARPALLI UNITS 3 & 4**

**VOLUME – IIB**

**TECHNICAL SPECIFICATION  
FOR  
*SCREENED CONTROL CABLES***

**SPECIFICATION NO: *PE-TS-391-507-E004*  
REVISION: 0**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA, UP (INDIA) – 201301**



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-391-507-E004

VOLUME II-B

SECTION -

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SHEET 1 OF 1

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**IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION  
IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS.**

-----  
BIDDER'S STAMP & SIGNATURE  
(REFER INSTRUCTION NO. 1 OF "INSTRUCTIONS TO BIDDERS")



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**INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS**

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer:
  - a. Unpriced Price Schedule (Annexure-A: BOQ, as enclosed with the specification) with bidder's signature and company stamp.
  - b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
  - c. A copy of previous sheet ("List Of Contents"), with bidder's signature and company stamp.
2. No technical submittal such as copies of type test certificates, data Sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.
3. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the cable description/ quantities, notes etc. from those given in Annexure-A to Section-C of specification [Bill Of Quantities] shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).

-----  
BIDDER'S STAMP & SIGNATURE

|                                                                                   |                                                                                      |                                       |                |
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|  | DOCUMENT TITLE<br><br><b>TECHNICAL SPECIFICATION FOR<br/>SCREENED CONTROL CABLES</b> | SPECIFICATION NO. PE-TS- 391-507-E004 |                |
|                                                                                   |                                                                                      | VOLUME II B                           |                |
|                                                                                   |                                                                                      | SECTION                               |                |
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### PREAMBLE

1 The Tender documents contain three (3) volumes. The bidder shall meet the requirements of all three volumes.

#### 1.1 VOLUME - I CONDITIONS OF CONTRACT

This consists of four parts as below:

- Volume – IA** This part contains Instructions to bidders for making bids to BHEL.
- Volume – IB** This part contains General Commercial Conditions of the Tender & includes provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.
- Volume – IC** This part contains Special Conditions of Contract.
- Volume – ID** This part contains Commercial Conditions for Erection & Commissioning site work, as applicable.

#### 1.2 VOLUME – II TECHNICAL SPECIFICATIONS

Technical requirements are stipulated in Volume – II, which comprises of:-

- Volume – IIA** General Technical Conditions.
- Volume – IIB** Technical Specification including Drawings, if any.

#### 1.3 VOLUME – IIB

This volume is sub-divided in to following sections:-

- Section – A:** This section outlines the Intent of Specification.
- Section – B:** This section provides “Projection Information”.
- Section – C:** This section indicates Technical Requirements specific to Contract, not covered in Section – D.
- Section – D:** This section comprises of Technical requirements specific to Contract.

**Data Sheet-A:** Specific data and other requirements pertaining to the equipments.

**Data sheet–C:** Indicates data / documents to be furnished after the award of Contract as per agreed schedule by the vendor (as applicable)



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**SECTION – 'A'**

**SCOPE OF ENQUIRY**



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**SCOPE OF ENQUIRY**

- 1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **Screened Control Cables** as mentioned in different sections of this specification for **2X660 MW IB VALLEY, OPGCL TPS**.
- 2.0 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.
- 3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the Technical Specification.
- 4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.
- 5.0 Requirements of the specification including the QP shall be agreed upon for total compliance by bidders without any deviations. Price offers of only those bidders complying with this requirement shall be acceptable
- 6.0 The documents shall be in English language and MKS system of units.



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## **SECTION – 'B'**

### **PROJECT INFORMATION**



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**PROJECT INFORMATION****INTRODUCTION**

|    |                                          |                                                                                                       |
|----|------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 1. | Owner                                    | OPGCL                                                                                                 |
| 2. | Project                                  | 2X660 MW OPGCL IB VALLEY BANHARPALLI TPP.                                                             |
| 3. | Owner's consultant                       | DCPL KOLKATTA                                                                                         |
| 4. | Location                                 | JHARSUGUDA DISTT. OF ORISSA.                                                                          |
| 5. | Nearest Airport                          | Bhubaneswar                                                                                           |
| 6. | Nearest Railway Station                  | Belapur (40 kms)<br>Jharsuguda (40 kms)                                                               |
| 7. | Access to site                           | From Jharsuguda railway station<br>By bus or taxi                                                     |
| 8. | Site data                                |                                                                                                       |
| A  | Altitude                                 | 199.5 M above Mean Sea Level                                                                          |
| B  | Ambient Air Temperature                  |                                                                                                       |
| 1. | Design maximum                           | 48°C                                                                                                  |
| 2. | Design Minimum                           | 04°C                                                                                                  |
| 3. | Design Wet Bulb                          | 38.9/28.0/33.4°C (summer/ winter/<br>monsoon)                                                         |
| C  | RELATIVE HUMIDITY                        |                                                                                                       |
|    | Average Relative Humidity                | 21/33/87% (summer/ winter/<br>monsoon)                                                                |
| D  | RAINFALL                                 |                                                                                                       |
| 1. | Average Annual Rainfall                  | 1460 mm                                                                                               |
| 2. | Maximum Recorded in 24 Hrs.              | 257.8 mm                                                                                              |
| E  | WIND VELOCITY & PRESSURE [AS PER IS:875] |                                                                                                       |
| 1. | Basic wind speed at 10 m height          | In accordance with IS-875 (Part 3)<br>– 1987 (reaffirmed 2003) for a basic<br>wind speed of 44 m/sec. |



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|              |                                                                                                                    |                                                                                                     |
|--------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 2.           | Average Wind Velocity                                                                                              | Summer: 37 – 45 km/hr<br>Winter: 15 - 26 km/hr<br>Maximum: 259 km/hr (cyclonic)                     |
| <b>F</b>     | <b>SEISMIC ZONE</b>                                                                                                | Zone-3 as per IS-1893 (2002)                                                                        |
| <b>9.0</b>   | <b>Power Supply</b>                                                                                                |                                                                                                     |
|              | a) In plant generation                                                                                             | 21 kV $\pm$ 5%, 3ph, 50 $\pm$ 3%Hz                                                                  |
|              | b) In plant distribution                                                                                           | 11 kV $\pm$ 10%, 3ph, 3 W, 50 Hz (+ 3% to -5% )<br>3.3 kV $\pm$ 10%, 3ph, 3 W, 50 Hz (+ 3% to -5% ) |
|              | c) Motor rated above 200 kW& up to 1500 kW                                                                         | 3.3 kV $\pm$ 10%, 3ph, 3 W, 50 Hz (+ 3% to -5% )                                                    |
|              | d) Motor rated above 200W to 200kW                                                                                 | 415V $\pm$ 10%, 3ph, 50 Hz (+ 3% to - 5% )                                                          |
|              | e) Motors rated 200 W and below, Lighting and small power                                                          | 240V $\pm$ 10%, 1ph, 50 Hz (+ 3% to - 5% )                                                          |
|              | f) DC Motors                                                                                                       | 220V DC $\pm$ 10%, 2 wire ungrounded system                                                         |
|              | g) Control supply for relay panel/ 6.6kV breakers/415V breakers                                                    | 110V DC $\pm$ 10%, 2 wire ungrounded system                                                         |
|              | h) UPS for instrumentation & Control system                                                                        | 415V AC $\pm$ 10 %, 3 ph, 50 Hz (+ 3% to -5% )                                                      |
|              | i) Control supply for 415V Motor contactors/AC Control circuits [to be generated in MCC /panel by vendor]          | 240V AC $\pm$ 10%, 50 Hz (+ 3% to - 5% )                                                            |
|              | j) Diesel Generator emergency supply                                                                               | 415V $\pm$ 10%, 3ph, 3W, 50 Hz (+ 3% to -5% )                                                       |
|              | k) DC emergency lighting.                                                                                          | 220V DC (+ 10% to -15%), 2 wire ungrounded system                                                   |
| <b>NOTE:</b> | <b>1. All equipment except generator shall be suitable for any combination of voltage and frequency variation.</b> |                                                                                                     |



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|             |                                                                                                                      |                                                                                                                                                   |
|-------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>2. Any other power supply requirement shall be derived by the vendor from the above available power supplies.</b> |                                                                                                                                                   |
| <b>10.0</b> | <b>a) Design ambient temperature for electrical equipment in non-air conditioned area</b>                            | 50°C                                                                                                                                              |
|             | <b>a) Design ambient temperature for electrical equipment in air conditioned area</b>                                | During Summer & Monsoon: 23 ± 1°C & RH 50% ± 5% for main control room.<br>During Summer & Monsoon: 24 ± 1°C & RH 50% ± 5% for non critical areas. |
| <b>11.0</b> | <b>Fault levels</b>                                                                                                  |                                                                                                                                                   |
|             | a) 400 kV                                                                                                            | 50 kA rms for 1 sec.                                                                                                                              |
|             | b) 21 kV                                                                                                             | 145 kA rms for 1 sec.                                                                                                                             |
|             | c) 11 kV                                                                                                             | 40 kA rms for 1 sec.                                                                                                                              |
|             | d) 3.3 kV                                                                                                            | 40 kA rms for 1 sec.                                                                                                                              |
|             | e) 415 V                                                                                                             | 50 kA rms for 1 sec.                                                                                                                              |



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## **SECTION – 'C'**

### **SPECIFIC TECHNICAL REQUIREMENTS**



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**1.0 SCOPE OF ENQUIRY**

- 1.1 This enquiry covers the supply of the **screened control cables** conforming to this specification.
- 1.2 General technical requirements of the cables are indicated in Section-D and Datasheet-A. Project specific technical/ quality requirements/ changes are listed below.
- 1.3 Cables shall conform in all respects to the requirements stipulated in all the above parts of the specification.
- 1.4 The stipulations of Section-C, followed by those of Datasheet-A shall prevail in case of any conflict between the stipulations of Section-C, Datasheet-A and Section-D.

**2.0 BILL OF QUANTITIES:**

- 2.1 Quantity requirements shall be as per Annexure-A1 for Main supply, enclosed with this section.
- 2.2 The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ enclosed with this specification. The unit prices shall apply for adjustment of variation in quantity as stipulated above. (Type Test charges to be included in price of cable.)
- 2.3 The cable quantities will be released for manufacture in more than one lot. Ordered quantities, which are indicated in the Bill of Quantities, shall be released for manufacture along with LOI. Manufacturing of Lot-I cables shall be done after the approval of technical and quality documentation and supplies shall be completed within delivery time as per NIT. Subsequent lots shall be cleared for manufacture based on progress of engineering and site requirements.
- 2.4 Delivery schedule for the package shall be given separately to the bidders for compliance.
- 2.5 Bidder's offer shall be for complete scope as per specification. Part offers are not acceptable.

**3.0 SPECIFIC TECHNICAL REQUIREMENTS**

- 3.1 Specific technical requirements shall be as listed below:

**3.1.1 Technical:**

| S. No. | Reference Clause No. of Section D (if any) | Specific Requirement/ Change                                                                                                                                                                                                                                                                                                                                |
|--------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 2.4.1 b, c & d                             | May be read as - 2.4.1 (b). Additionally "The type tests are required to be conducted as indicated in Annexure to QAP and the same shall be offered for inspection (conduction of type tests shall be witnessed by BHEL). Bidder to indicate unit price of cables inclusive of type test charges. No separate charges shall be payable for type tests.      |
| 2      | 2.4.1 e                                    | Refer S. No. 1 above.                                                                                                                                                                                                                                                                                                                                       |
| 3      | 4.1                                        | Two signed and stamped copies of the following shall be furnished by all bidders as technical offer :<br>(i) Un-priced Price Schedule Annexure-A1 as enclosed with the specification) with bidder's signature and company stamp.<br>(ii) A copy of "Instruction to Bidders for Preparing Technical Offer" sheet, with bidder's signature and company stamp. |

|                                                                                   |                                                                                      |                                      |                |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------|----------------|
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|  |  |                                                                                                                                                                                                                                                                                                                                                                                                      |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>(iii) A copy of "List of Contents" sheet, with bidder's signature and company stamp.</p> <p><b><u>No other documentation is required to be submitted as technical offer. Any information contained in other parts of the offer (e.g. covering letter, annexure, etc.) which is deviating from specification requirements in any way shall not be considered by BHEL as part of offer.</u></b></p> |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 3.1.2: Quality/ Inspection:

| S. No. | Reference Clause No. of Section D (if any) | Specific Requirement/ Change                                                                                                                                                                                                              |
|--------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 2.2                                        | QP (Including Annexure to QAP) enclosed with spec. shall be stamped and signed by bidders as token of acceptance. The QP shall be submitted during contract stage for customer/BHEL approval without any commercial implications to BHEL. |
| 2      | 2.4.1(d)                                   | All Tests shall be conducted as per contract. Conduction of Testing requirements mentioned in datasheet-A & Annexure to QAP.                                                                                                              |

- 3.1.3. Non-returnable wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to the entire drum and Outermost layer covered with waterproof paper. Entire surface of the cable drum shall be painted.

## 4.0 SPECIFIC QUALITY ASSURANCE REQUIREMENTS

### 4.1 Quality Plan applicable for project:

BHEL Standard Quality Plan no. PE-QP-999-507-E004, R0 (Enclosed with specification).

- 4.2 Cables supplied shall be subjected to type tests, routine tests and acceptance tests as specified below and according to relevant standards.

### 4.3 Type, Acceptance & Routine Test Requirements:

- Refer Quality Plan and Annexure-I of Quality plan for Type tests, Acceptance tests & Routine tests requirement.
- Minor changes in the final Type Test Procedures (which shall be to BHEL approval during contract stage) shall be acceptable to Vendor without any commercial implication.

- 5.0 Bidders shall confirm total compliance to specification without any deviations from the technical/ quality assurance requirements.

- 6.0 The list and schedule of deliverables to be submitted by successful bidder shall be as Annexure- B.

- 7.0 Document distribution schedule for the project shall be as per Annexure-C



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**ANNEXURE-B**

By Successful Bidder (for approval during contract stage) [Document No. &amp; title as given below]

**SCREENED CONTROL CABLES**

| SL. No. | DOCUMENT TITLE                                           | DWG. / DOCUMENT No. | SUBMISSION SCHEDULE                                    |
|---------|----------------------------------------------------------|---------------------|--------------------------------------------------------|
| 1       | Data Sheet for Screened Control Cables                   | PE-V0-391-507-E141  | Within Two weeks from the date of LOI                  |
| 2       | Cross-sectional Drawings for Screened Control Cables     | PE-V0-391-507-E143  | Within Two weeks from the date of LOI                  |
| 3       | Type Test Procedure for Screened Control Cables          | PE-V0-391-507-E142  | Within Two weeks from the date of LOI                  |
| 4       | Quality Plan for Screened Control Cables                 | PE-V0-391-507-E916  | Within Two weeks from the date of LOI                  |
| 5       | Type Test Reports for Tests conducted in last five years | PE-V0-391-507-E145  | Within Two weeks from the date of LOI                  |
| 6       | Type Test Reports for Tests conducted for this contract  | PE-V0-391-507-E144  | Within a week from the date of conduction of Type Test |



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**ANNEXURE-C****DOCUMENTS / DRAWINGS DISTRIBUTION SCHEDULE****No. of prints to be submitted by vendor after award of contract shall be as under:**

| S.N. | Drawings and documents                      | Soft and Hard Prints      |
|------|---------------------------------------------|---------------------------|
| 1.0  | <u>DRAWING FOR APPROVAL</u>                 |                           |
| 1.1  | For approval                                | Soft+2 Hard Print         |
| 1.2  | For customer approval                       | Soft+2 Hard Print         |
| 1.3  | For final distribution                      | Soft+2 CD +5 Hard Print   |
| 2.0  | <u>DRAWING FOR REFERENCE</u>                |                           |
| 2.1  | For reference                               | Soft+2 Hard Print         |
| 2.2  | For final distribution                      | Soft+2 CD+5 Hard Print    |
| 3.0  | CERTIFICATE, REPORTS ETC.                   | Soft+2 Hard Print         |
| 4.0  | AS BUILT DRAWINGS ( IF REQUIRED )           | Soft+2 CD+8 Hard Print    |
| 5.0  | O&M MANUAL                                  |                           |
| 5.1  | Draft for approval                          | Soft +3 CD+ 5 Hard Print  |
| 5.2  | For final distribution                      | Soft +3 CD + 8 Hard Print |
| 6.0  | QUALITY PLAN / Field quality plan / PG test | Soft + 2 Hard Print       |

|  |                                                                |  |                                       |                  |
|--|----------------------------------------------------------------|--|---------------------------------------|------------------|
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|  |                                                                |  | SHEET                                 |                  |

2 X 660 MW IB VALLEY, OPGCL TPS.

**ANNEXURE - A1  
BOQ-CUM-PRICE SCHEDULE FOR SCREENED CONTROL CABLE**

**A.0) MAIN SUPPLY**

**1.1) Individual & Overall Screened Cable (Type-F)**

Multi pair (twisted) individual & overall shielded instrumentation cables. (Type-F)

| S.No. | Item Code   | Item Description                   | UOM | Order Quantity (Mtrs.) | Drum Length (Mtrs.) | Unit Price (Ex-Works) Rs | Total Price (Ex-Works) Rs |
|-------|-------------|------------------------------------|-----|------------------------|---------------------|--------------------------|---------------------------|
| 1.1.1 | 507-31037-A | 225V TYPE F(IO) 12P - 0.5 ARMoured | M   | 2000                   | 1000                |                          |                           |
| 1.1.2 | 507-31041-A | 225V TYPE F(IO) 20P - 0.5 ARMoured | M   | 500                    | 500                 |                          |                           |

**1.2) Overall Screened Cable (Type-G)**

Multi pair (twisted) overall shielded instrumentation cables. (Type-G)

| S.No. | Item code   | Item Description                  | UOM | Order Quantity (Mtrs.) | Drum Length (Mtrs.) | Unit Price (Ex-Works) Rs | Total Price (Ex-Works) Rs |
|-------|-------------|-----------------------------------|-----|------------------------|---------------------|--------------------------|---------------------------|
| 1.2.1 | 507-31069-A | 225V TYPE G(O) 8P - 0.5 ARMoured  | M   | 38000                  | 1000                |                          |                           |
| 1.2.2 | 507-31053-A | 225V TYPE G(O) 12P - 0.5 ARMoured | M   | 13000                  | 1000                |                          |                           |

**Notes : (Applicable for main supply)**

- Quantities indicated above at **S. No. 1.1 & 1.2** shall be known as Order Quantities. The variation in quantities of all sizes for **Main supply (S. No. 1.1 & 1.2 )** put together shall be limited to (-) 30% to (+) 30% of the total contract value derived on the basis of the Ordered quantities for this very project.
- The quantities will be released for manufacture in more than one lot.
- The quantities, which are indicated above, shall be released for manufacture along with LOI. However, manufacturing of the quantities shall be done after the approval of technical and quality documentation. Subsequent lots shall be cleared for manufacture based on progress of engineering and site requirements.
- Delivery schedule shall be as per NIT.
- The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ in the Price Schedule. The unit price shall apply for adjustment of variation in quantity as stipulated above.
- Overall variation on dispatched quantity of each size shall be (-) 2% and (+) 0%. Cables consumed for testing and inspection shall be to bidder's account.
- Standard drum length shall be 1000 metres upto 12P & Standard drum length shall be 500 metres above 12P. The tolerance of drum length shall be + 5%. Short lengths of individual cable size not less than 300m may be accepted only in the final drum length to complete the supply within the overall variation limit stipulated above.
- In case of the quantities of any one lot cleared by BHEL for manufacturing are manufactured and offered for inspection by successful bidder in more than one batch, BHEL reserves the right to witness type testing on all batches without any price implications.
- Type Test charges are deemed to be included in price of cables. No separate Type Test charges to be quoted by bidder.



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**ANNEXURE: B-I**

**CORE IDENTIFICATION / PAIR  
IDENTIFICATION**



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**ANNEXURE : B-I**

The cable cores shall be colour coded as mentioned below:

| PAIR | CORE | COLOUR |
|------|------|--------|
| 1 st | 1 st | Blue   |
| 1 st | 2 nd | Red    |
| 2 nd | 1 st | Grey   |
| 2 nd | 2 nd | Yellow |
| 3 rd | 1 st | Green  |
| 3 rd | 2 nd | Brown  |
| 4 th | 1 st | White  |
| 4 th | 2 nd | Black  |

Each four pair is laid to form one unit and wound with Mylar tape. The cores of each unit shall then be identified by colour bands for cables of more than 4-pair. eg. All eight cores of the first unit shall have a single band of pink colour (preferably rose pink).



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS- 391-507-E004

VOLUME II B

SECTION D

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SHEET 1 OF 3

**SECTION – 'D'**

**STANDARD TECHNICAL SPECIFICATION**



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS- 391-507-E004

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**1.0 TECHNICAL REQUIREMENTS**

- 1.1 Technical requirements for Screened control cables shall be as indicated in this section, in addition to those specified in Section- C and Datasheet-A as attached for project specific requirements.

**2.0 QUALITY ASSURANCE REQUIREMENTS**

- 2.1 Bidder shall confirm compliance with the BHEL Quality Plan as attached with the specification without any deviations.
- 2.2 In the event of BHEL Quality Plan not being applicable for a project (as indicated in section-C of the project specification), the successful bidder shall submit the Manufacturing Quality Plan (MQP) for approval by BHEL/ Owner (as applicable) during detailed engineering stage without any commercial implications.
- 2.3 Bidders shall submit their list of proven sub-vendors for raw materials, which will be subject to BHEL/ Customer approval.
- 2.4 Type testing requirements and routine/ acceptance testing requirements shall be as detailed below.

**2.4.1 Type Tests on Cables**

- a. All cables to be supplied shall conform to type tests as per relevant standards and proven type.
- b. The bidder shall furnish the reports of all the type tests carried out in within last five years of the date of bid opening. These reports should be for the tests conducted either in government approved third party laboratory or witnessed by client (such as major utilities/ industries) on identical/ similar cables to those ordered under this contract.
- c. In case bidder is not able to submit report of type test(s) conducted in last five years, or in case type tests report(s) are not found to be meeting the specification/ relevant standard requirements, then all such tests shall be conducted under this contract by the bidder free of cost to BHEL, and reports shall be submitted for approval. No charges shall be paid for testing under such circumstances.
- d. Irrespective of the bidder furnishing type test report as indicated above, BHEL may get type tests conducted on the lots offered for inspection. Separate price shall be quoted for the conduction of type testing per lot, which shall be used for cost comparison. A maximum of three lots shall be considered for price comparison purposes on account of type testing. However, type-testing charges shall be paid as per type test conducted.
- e. Minor changes in the final Type Test Procedures (which shall be to approval during contract stage) shall be without any commercial implication.

**2.4.2 Routine and Acceptance Tests**

- a. Routine testing shall be conducted in line with the applicable standards and as per the Manufacturing Quality Plan approved for the project for every lot offered for inspection.
- b. Acceptance tests shall be conducted on every lot offered for inspection as per details indicated in Datasheet A.
- c. Cost of conduction of routine and acceptance testing shall be deemed to have been included in the quoted supply prices.

**2.4.3 Cost of cables consumed for testing shall be to bidder's account.**



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**3.0 Packing**

- 3.1 Cables shall be supplied in non-returnable heavy construction drums. All wooden parts shall be manufactured from seasoned wood treated with copper naphthenates/ zinc naphthenates (refer IS: 401). All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum.

**4.0 PROJECT SPECIFIC TECHNICAL AND QUALITY DOCUMENTATION TO BE SUBMITTED****4.1 By All Bidders (PLEASE REFER CLAUSE 3.1.1 at sl. No. 3, SECTION-C OF TECHNICAL SPECIFICATION)**

As technical offer:

- a. A copy of Section B (Project Information) as enclosed with enquiry with bidder's signature and company seal.
- b. A copy of Section C (Project Specific Technical Requirements) as enclosed with enquiry with bidder's signature and company seal.
- c. A copy of Annexure-A to Section-C, Bill of Quantities as enclosed with enquiry with bidder's signature and company seal.
- d. A copy of Datasheet-A as enclosed with enquiry with bidder's signature and company seal.

**No other documentation is required to be submitted as technical offer. Any information contained in other parts of the offer (e.g. covering letter, annexures, etc.) which is deviating from specification requirements in any way shall not be considered by BHEL as part of offer.**

**4.2 By Successful Bidder (for approval during contract stage)****(PLEASE REFER CLAUSE 7 SECTION-C OF TECHNICAL SPECIFICATION)**

- a. Datasheet C in the format provided to the successful bidder along with LOI.
  - b. Cross-section drawings of the cables
  - c. Manufacturing Quality Plan in case BHEL SQP is not applicable.
  - d. List of sub-vendors/ suppliers of raw materials
  - e. Type test procedure
  - f. Field Quality Plan
  - g. Technical catalogues/ literature for the cables.
- 4.3 Two copies of the above documentation shall be submitted for first review. Number of copies to be submitted for second and subsequent submissions (till Cat-I approval is accorded), and those for final distribution prints of approved documentation and test certificates shall be as indicated separately in section C.
- 4.4 Wherever required, soft copy of all approved technical/ quality documentation shall be submitted as specified without any additional commercial implication. Soft copies may be required both in native file format (e.g. MS Word/ MS Excel) as well as PDF files.



# **TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES**

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## **DATA SHEET-A** **SPECIFIC TECHNICAL REQUIREMENTS**

- 1.0 Type of cable : FRLS SCREENED CONTROL CABLES
- 2.0 Standards Applicable : VDE 0815, VDE 0207 Part-4 & Part-5, VDE 0816, VDE 0472, IS 1554-I, IEEE-383, SEN 4241475 class F3, IEC 332 Part-1, IEC 332 Part-3 Cat-B, IS 10810 (latest editions and its amendments).
- 3.0 Voltage grade : 225 V (peak value)
- 4.0 CONDUCTOR
  - a) Material : High conductivity multi stranded Annealed Tinned Copper
  - b) Grade : Electrolytic
  - b) Standard applicable : VDE 0815
  - c) Min number of strands, Dia : 7, 0.3 mm (nom), 0.5 sq.mm  
and cross sectional area
- 5.0 INSULATION
  - a) Material : PVC compound Type –YI3, as per VDE 0207 Part 4
  - b) Application : Extruded
  - c) Insulation thickness:
    - Min/ Nom/ Max : 0.28 / 0.3 / 0.35 (for 0.5 sq. mm)
  - d) Volume resistivity (Min) :  $1 \times 10^{14}$  at 20 deg .C &  $1 \times 10^{11}$  at 70 deg .C  
in ohm-cm
- 6.0 LAYING OF CORES
  - a) Min. number of twist per : 20  
Metre for paired cables.
  - b) Maximum lay of individual : 50 mm  
twisted pair
  - c) Diameter of core : In accordance with clause 5 (c)



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7.0 IDENTIFICATION OF CORES : Colour coding chart attached

### 8.0 INDIVIDUALLY SCREENED

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Overlap : Minimum 20%
- d) Min thickness (Micron) : 28

### 9.0 OVERALL SCREENED

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Over lap : Minimum 20%
- d) Min. thickness (Micron) : 55

### 11.0 DRAIN WIRE

To be provided separately for individual pair shield (wherever applicable) and overall shield.

- a) Material : Annealed Tin coated copper conductor as per VDE: 0815
- b) Size (sq.mm.) : 7/ 0.51 sq.mm

### 11.0 ACCESSORIES (BEDDING, BINDER, TAPE REQ.)

- a) Material : Flame Retardant Mylar Tape

### 12.0 INNER SHEATH

- a) Material : Extruded PVC (Compound YM1) as per VDE 0207 Part 5
- b) Thickness : As per VDE
- b) Whether FRLS : NO
- c) Fillers : Acceptable, Non hygroscopic flame retardant (as required for maintaining cable circularity)
- d) Material of fillers : Same as inner sheath
- e) Colour : BLACK



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e) Method of application

i) With fillers : Pressure/ Vacuum extruded

ii) Without fillers : Pressure extruded

13.0 ARMOUR :

a) Material : Galvanised steel round wire, Conforming to IS: 3975

b) Size : As per IS 1554 Part 1

c) Coverage : 90%

d) Breaking load of joint : 95% of normal armour

e) Method of jointing : Welding

14.0 OUTER SHEATH

a) Material : Extruded PVC (compound YM1) as per VDE 0207 Part-5

b) Thickness : As per VDE 0816 and VDE207 Part-5

Minimum Thickness at  
any point : 1.8 mm

Nominal Thickness at  
any point : >1.8 mm

c) Application : Extruded

d) Colour : GRAY

e) Whether FRLS : YES

f) Other : Resistant to water, Termite, rodent Attack

15.0 RIP CORD : Non metallic undersheath

16.0 CHARACTERISTICS OF FRLS SHEATH & FLAMMABILITY TESTS

a) Oxygen Index : 29% Minimum as per ASTM D 2863

b) Temperature Index : 250 °C Minimum as per ASTM D 2863

c) Acid gas generation : less than 20% by weight (As per IEC-60754-1)

d) Smoke density rating : Not more than 60% (As per ASTM D 2843)



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Derived as Average area under curve when the results of Smoke density plotted on a curve indicating light absorption v/s time as per ASTM D 2843

- |      |                                                      |             |                                                                                                                                                                                                                                             |
|------|------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| e)   | Flammability Test                                    | :           | As per IEC 332 Part-1, IEC 332 Part-3 Cat-B, SEN-SS-424-1475 (F3) & IEEE-383.                                                                                                                                                               |
| 17.0 | TOLERANCE ON OVERALL DIAMETER                        | :           | ± 2mm max. over the declared value in Technical Data Sheet                                                                                                                                                                                  |
| 18.0 | VARIATION IN DIA                                     | :           | Not more than 1.0 mm throughout the length of cable.                                                                                                                                                                                        |
| 19.0 | OVALITY AT ANY CROSS-SECTION                         | :           | Not more than 1.0 mm.                                                                                                                                                                                                                       |
| 20.0 | DRUM LENGTH/ Material                                |             |                                                                                                                                                                                                                                             |
| a)   | Standard drum length                                 | :           | 1000 metres: upto and including 12 pairs<br>500 metres: above 12 pairs                                                                                                                                                                      |
| b)   | Tolerance on drum length                             | :           | ±5%                                                                                                                                                                                                                                         |
| c)   | Material                                             | :           | Wooden drums                                                                                                                                                                                                                                |
| 21.0 | Markings on Outer Sheath                             |             |                                                                                                                                                                                                                                             |
| a)   | Progressive sequential Length marking to be provided | :           | YES @ 1000 mm (max.) by Printing/ embossing                                                                                                                                                                                                 |
| b)   | Progressive marking @ 5M                             | :           | Manufacturers name, type of insulation, FRLS, cable Size (cross- section & no. of pairs), voltage grade, Type of cable (i.e. Type F/G), year of manufacture by embossing. Customer name i.e. 'BHEL-PEM' & 'OPGCL' shall also be marked @5m. |
| 22.0 | TECHNICAL PARAMETERS                                 | :           | Refer Table –1 attached                                                                                                                                                                                                                     |
| 23.0 | TEST VOLTAGE                                         |             |                                                                                                                                                                                                                                             |
|      |                                                      | Core – Core | Core- shield                                                                                                                                                                                                                                |
| a)   | High voltage test                                    | :           | 1.5 kV RMS for 1 min      1.0 kV RMS for 1 min                                                                                                                                                                                              |
| b)   | Resistance to direct current test                    | :           | 0.22 kV DC for 240 hrs/ 10 days                                                                                                                                                                                                             |
| 24.0 | RODENT & TERMITE REPULSION TEST                      | :           | <b>Presence of lead shall be confirmed.</b><br>The test shall be carried out to also note the presence of rodent and termite repelling                                                                                                      |



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chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium-sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

**TABLE-1**

| Parameter                                   | 0.5 mm <sup>2</sup> (I & OS) type-F | 0.5 mm <sup>2</sup> (OS) type-G |
|---------------------------------------------|-------------------------------------|---------------------------------|
| Mutual Capacitance (max.) at 0.8 kHz, nF/Km | <b>120</b>                          | <b>100</b>                      |
| Conductor Loop Resistance (max.), Ohm/Km    | <b>73.4</b>                         | <b>73.4</b>                     |
| Insulation Resistance (min), M Ohm/ Km      | <b>100</b>                          | <b>100</b>                      |
| Cross Talk Figure (min) at 0.8kHz, dB       | <b>60</b>                           | <b>60</b>                       |
| Characteristic impedance(max.) at 1 kHz     | <b>320</b>                          | <b>340</b>                      |
| Attenuation(max.) at 1 kHz db/Km            | <b>1.2</b>                          | <b>1.2</b>                      |

**Notes:**

1. The voltage grade of instrumentation cable shall be 225 V (Peak).
2. Cable parameters indicated above are at 20 deg C (+/- 3 deg )

|                                                                                   |                                                                                      |                                      |                  |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------|------------------|
|  | DOCUMENT TITLE<br><br><b>TECHNICAL SPECIFICATION FOR<br/>SCREENED CONTROL CABLES</b> | SPECIFICATION NO. PE-TS-391-507-E004 |                  |
|                                                                                   |                                                                                      | VOLUME II-B                          |                  |
|                                                                                   |                                                                                      | SECTION - Data sheet- A              |                  |
|                                                                                   |                                                                                      | REVISION 0                           | DATE: 06.09.2014 |
|                                                                                   |                                                                                      | SHEET 6 OF 6                         |                  |



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**DATA SHEET-C**

**STANDARD SPECIFICATION - DATASHEET-C**(FOR SCREENED CONTROL CABLES)  
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

| S.No. | Particulars                                                        | Unit   | Description |
|-------|--------------------------------------------------------------------|--------|-------------|
| 1     | Manufacturer's name                                                | -      |             |
| 2     | Reference design standards                                         | -      |             |
| 3     | Conductor size                                                     | sq. mm |             |
| 4     | Rated Voltage                                                      | V      |             |
| 5     | Number of pairs                                                    | No.    |             |
| 6     | Cable suitable for both earthed<br>& unearthed system              | -      |             |
| 7     | Conductor                                                          |        |             |
|       | a) Material                                                        | -      |             |
|       | b) Reference Standard                                              | -      |             |
|       | c) Grade                                                           | -      |             |
|       | d) No. of strands                                                  | No.    |             |
|       | e) Diameter of strands (nom.)                                      | mm     |             |
|       | f) Approx. dia of conductor                                        | mm/    |             |
|       | Cross Section area                                                 | sq. mm |             |
|       | g) Maximum conductor resistance per Km at 20°C                     | ohm    |             |
| 8     | Insulation                                                         |        |             |
|       | a) Reference Standard                                              | -      |             |
|       | b) Material composition                                            | -      |             |
|       | c) Minimum thickness                                               | mm     |             |
|       | d) Nom. Thickness                                                  | mm     |             |
|       | e) Max. thickness                                                  | mm     |             |
|       | f) Minimum volume resistivity as per IS 5831                       | Ohm cm |             |
|       | g) Dielectric constant                                             | -      |             |
|       | h) The insulation will withstand conductor operating temp. of 85°C | -      |             |
|       | i) Core diameter including insulation                              | mm     |             |

**STANDARD SPECIFICATION - DATASHEET-C**(FOR SCREENED CONTROL CABLES)  
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

| S.No. | Particulars                                    | Unit        | Description |
|-------|------------------------------------------------|-------------|-------------|
| 9     | Core laying                                    |             |             |
|       | a) Whether cores are twisted.                  | -           |             |
|       | b) Maximum lay of twist                        | mm          |             |
| 10    | Individual Shield                              |             |             |
|       | a) Material                                    | -           |             |
|       | b) Thickness of tape                           | mm          |             |
|       | c) Coverage/ Overlap                           | %           |             |
|       | d) Noise interference better than              | dB          |             |
| 11    | Drain wire for individual shield               |             |             |
|       | a) Reference standard                          | -           |             |
|       | b) Size/ No. of strands                        | sq. mm/ no. |             |
|       | c) Material                                    | -           |             |
|       | d) Resistance of drain wire per km at 20 deg.C | ohm         |             |
| 12    | Overall shield                                 |             |             |
|       | a) Material                                    | -           |             |
|       | b) Thickness of tape                           | mm          |             |
|       | c) Coverage/Overlap                            | %           |             |
|       | d) Noise interference better than              | dB          |             |
| 13    | Drain wire for overall shield                  |             |             |
|       | a) Reference standard                          | -           |             |
|       | b) Size/ No.of strands                         | sq. mm/ no. |             |
|       | c) Material                                    | -           |             |
|       | d) Resistance per Km at 20°C                   | Ohm/ km     |             |
| 14    | Fillers if applicable                          |             |             |
| 15    | Inner sheath                                   |             |             |
|       | a) Material, type and standard                 | -           |             |
|       | b) Whether FRLS                                | -           |             |
|       | c) Colour                                      | -           |             |
|       | d) Method of application                       | -           |             |
|       | e) Thickness (min)                             | mm          |             |
| 16    | Armour                                         |             |             |
|       | a) Material,                                   | -           |             |
|       | b) Minimum Coverage                            | %           |             |
|       | c) Method of jointing                          | -           |             |
|       | d) Breaking load of joint                      | -           |             |
|       | e) Size (approx.)                              | mm          |             |
|       | f) Dia of armour                               | mm          |             |
|       | g) No. of wires                                | mm          |             |
| 17    | Outer sheath                                   |             |             |
|       | a) Reference standard                          | -           |             |
|       | b) Material                                    | -           |             |
|       | c) Minimum thickness of sheath                 | mm          |             |
|       | d) Calculated dia under outersheath            | mm          |             |
|       | e) Oxygen index (as per ASTM D 2863)           | -           |             |

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BHEL DOCUMENT NO.  
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**STANDARD SPECIFICATION - DATASHEET-C**(FOR SCREENED CONTROL CABLES)  
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

| S.No. | Particulars                                                                 | Unit      | Description |
|-------|-----------------------------------------------------------------------------|-----------|-------------|
|       | f) Temperature index (in deg. C as per ASTM D 2863)                         | -         |             |
|       | g) Maximum acid gas generation as per IEC 754-1                             | %         |             |
|       | h) Maximum smoke density rating as per ASTM D 2843                          | %         |             |
|       | i) Colour of outer sheath                                                   | -         |             |
| 18    | Dia over laid-up core                                                       | mm        |             |
| 19    | Dia under armour                                                            | mm        |             |
| 20    | Dia above armour                                                            | mm        |             |
| 21    | Overall diameter of cable                                                   | mm        |             |
| 22    | Tolerance on overall diameter                                               | mm        |             |
| 23    | Weight of conductor                                                         | Kgs. / km |             |
|       | PVC (insulation, sheath & fillers)                                          | Kgs. / km |             |
|       | Armour                                                                      | Kgs. / km |             |
|       | Cable (approx.)                                                             | Kgs. / km |             |
| 24    | Cable parameters at 20°C (+/-3 deg. C)                                      |           |             |
|       | a) Conductor resistance (max)                                               | Ohm/ km   |             |
|       | b) Insulation resistance (min)                                              | M-Ohm     |             |
|       | c) Mutual capacitance at 0.8KHz (max)                                       | nF/ km    |             |
|       | d) Cross talk at 0.8KHz (min)                                               | dB        |             |
|       | e) Attenuation at 1 KHz (max)                                               | dB/ km    |             |
|       | f) Characteristic impedance max.                                            | Ohm       |             |
| 25    | Continuous operating temp. (deg.C)                                          | deg. C    |             |
| 26    | Whether complete cable Flame retardant as per IS-10810 Part-62 (Category-B) | -         |             |
| 27    | Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)  | -         |             |
| 28    | Identification                                                              |           |             |
|       | a) Length of cable marked at every mtr.                                     | -         |             |
|       | b) FRLS marked at every 5 mtrs                                              | -         |             |
|       | c) Each core of the pair numbered                                           | -         |             |
|       | d) Conductor identification details for pairs                               | -         |             |
|       | e) Details of cable markings                                                | -         |             |
| 29    | Test voltage                                                                |           |             |
|       | a) High voltage test/ Dielectric Strength                                   |           |             |
|       | i) Voltage (KV), Core - Core                                                | kV        |             |
|       | ii) Duration                                                                | min       |             |
|       | b) High Voltage test                                                        |           |             |
|       | i) Voltage (KV), Core - Screen                                              | V         |             |
|       | ii) Duration                                                                | min       |             |
|       | c) Resistance to direct current test                                        | -         |             |
|       | Voltage                                                                     | V         |             |
|       | Duration                                                                    | hrs/days  |             |
| 28    | Min bending radius                                                          | mm        |             |
| 29    | Ovality at any cross section                                                | mm        |             |
| 30    | Variation of dia through out cable length                                   |           |             |
| 31    | Cable cross-sectional drawings for each type of cable furnished             |           |             |

**STANDARD SPECIFICATION - DATASHEET-C**

(FOR SCREENED CONTROL CABLES)  
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)



| S.No. | Particulars                                                                                     | Unit | Description |
|-------|-------------------------------------------------------------------------------------------------|------|-------------|
| 32    | i) Length of single coil in a drum                                                              | M    |             |
|       | ii) Marking on drum                                                                             | -    |             |
|       | iii) Seasoned wood drum provided                                                                | -    |             |
|       | iv) Both ends of cable to be sealed with PVC/<br>Rubber caps to prevent water/ moisture ingress |      |             |
|       | v) Gross weight (approx.)                                                                       | kg.  |             |
|       | vi) Net weight (approx.)                                                                        | kg   |             |
| 33    | Type test procedures as per BHEL Technical<br>Spec. and other relevant standards enclosed.      |      |             |
| 34    | Anti termite & rodent test                                                                      |      |             |

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|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       |             |                           |                   |                                                    |                                            |                               |                             |   |     |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------|-------------------|----------------------------------------------------|--------------------------------------------|-------------------------------|-----------------------------|---|-----|------------|
|                                                                                                                                                                                                                                                                                                                       |                                                    | <b>QUALITY PLAN</b><br>SHEET 1 OF 5                                                                                                                                   |             | CUSTOMER : OPGCL          |                   | PROJECT : 2X660 MW IB TPS                          |                                            |                               | SPECIFICATION               |   |     |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       |             | BIDDER/ :<br>VENDOR       |                   | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E004, REV 0. |                                            |                               | NUMBER : PE-TS-391-507-E004 |   |     |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       |             | SYSTEM                    |                   | ITEM : INSTRUMENTATION CABLES                      |                                            |                               | SPECIFICATION<br>TITLE      |   |     |            |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                | COMPONENT/OPERATION                                | CHARACTERISTICS CHECK                                                                                                                                                 | CAT.        | TYPE/ METHOD OF CHECK     | EXTENT OF CHECK   | REFERENCE DOCUMENT                                 | ACCEPTANCE NORM                            | FORMAT OF RECORD              | SECTION                     |   |     | VOLUME III |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       |             |                           |                   |                                                    |                                            |                               | AGENCY                      | P | W   | V          |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       |             |                           |                   |                                                    |                                            |                               |                             |   |     |            |
| 1                                                                                                                                                                                                                                                                                                                                                                                                      | 2                                                  | 3                                                                                                                                                                     | 4           | 5                         | 6                 | 7                                                  | 8                                          | 9                             | 10                          |   |     | 11         |
| <b>Instructions:</b><br>1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no.<br>2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not. |                                                    |                                                                                                                                                                       |             |                           |                   |                                                    |                                            |                               |                             |   |     |            |
| 1.0                                                                                                                                                                                                                                                                                                                                                                                                    | <b>RAW MATERIAL</b>                                |                                                                                                                                                                       |             |                           |                   |                                                    |                                            |                               |                             |   |     |            |
| 1.1                                                                                                                                                                                                                                                                                                                                                                                                    | Copper Rods/ Wires<br>(For Conductor & drain wire) | <b>GENERAL :</b><br>1. Physical properties<br><br>2. Elec.Properties<br><br><b>SPECIFIC CHECKS :</b><br>a) Make<br>b) Grade<br>c) Resistivity                         | MA          | Physical Tests            | Sample            | Relevant Standard/<br>Approved datasheet           | Relevant Standard/<br>Approved datasheet   | Log book/ Test Cert.          | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Electrical Tests          | Sample            | -do-                                               | -do-                                       | -do-                          | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Verify                    | 100%              | Manufacturer approved source                       | Manufacturer approved source               | Log book/ Test Cert.          | 3/2                         | - | 1   |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | -do-                      | -do-              | IS 613/ Approved datasheet                         | IS 613/ Approved datasheet                 | -do-                          | 3/2                         | - | 1   |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Electrical Tests          | Manufacturer      | IS 613                                             | IS 613                                     | -do-                          | 3/2                         | - | 1   |            |
| 1.2                                                                                                                                                                                                                                                                                                                                                                                                    | PVC Compound (for insulation)                      | <b>GENERAL :</b><br>1. Physical properties<br><br>2. Elec.Properties<br><br><b>SPECIFIC CHECKS :</b><br>a) Make<br>b) Type/ Grade<br>c) Shelf life/ Storage condition | MA          | Physical Tests            | Sample            | Relevant Standard/<br>Approved datasheet           | Relevant Standard/<br>Approved datasheet   | Log book/ Test Cert.          | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Electrical Tests          | Sample            | -do-                                               | -do-                                       | -do-                          | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Verify                    | 100%              | Manufacturer approved source                       | Manufacturer approved source               | Log book/ Test Cert.          | 3/2                         | - | 1   |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | -do-                      | -do-              | Approved datasheet                                 | Approved datasheet                         | -do-                          | 3/2                         | - | 1   |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | -do-                      | -do-              | Compound Manufacturer std.                         | Compound Manufacturer std.                 | -do-                          | 3/2                         | - | 1   |            |
| 1.3                                                                                                                                                                                                                                                                                                                                                                                                    | Screen / Tapes/ Binders                            | 1. Make<br>2. Dimension<br>3. T.S. & Elongation<br>4. Chem. & Phys. Properties                                                                                        | MA          | Verify                    | 100%              | Manufacturer approved source                       | Manufacturer approved source               | TC & IR                       | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Measurement               | Manufacturer std. | Manufacturer datasheet/ Approved datasheet         | Manufacturer datasheet/ Approved datasheet | TC & IR                       | 3/2                         | - | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Physical Tests            | -do-              | Manufacturer datasheet                             | Manufacturer datasheet                     | -do-                          | 3/2                         |   | 1/2 |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | MA          | Chemical & Physical Tests | -do-              | Manufacturer std.                                  | Manufacturer std.                          | -do-                          | 3/2                         |   | 1/2 |            |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                   |                                                    |                                                                                                                                                                       | PARTICULARS |                           | BIDDER/VENDOR     |                                                    |                                            |                               |                             |   |     |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | NAME        |                           |                   |                                                    |                                            |                               |                             |   |     |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | SIGNATURE   |                           |                   |                                                    |                                            |                               |                             |   |     |            |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                    |                                                                                                                                                                       | DATE        |                           |                   |                                                    |                                            | BIDDER'S/VENDORS COMPANY SEAL |                             |   |     |            |

|  |                                                        | <b>QUALITY PLAN</b>                                                                                                                                                                                     |                                  | CUSTOMER : OPGCL                                                                   |                                                    | PROJECT : 2X660 MW IB TPS                                                                                                                 |                                                                                                                                           |                                                                              | SPECIFICATION                          |                            |                                  |   |                                                                  |
|-----------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------|----------------------------|----------------------------------|---|------------------------------------------------------------------|
|                                                                                   |                                                        | BIDDER/ :<br>VENDOR                                                                                                                                                                                     |                                  | TITLE<br>QUALITY PLAN<br>NUMBER: PE-QP-999-507-E004, REV 0.                        |                                                    |                                                                                                                                           | NUMBER : PE-TS-391-507-E004                                                                                                               |                                                                              |                                        | SPECIFICATION :<br>TITLE   |                                  |   |                                                                  |
| SHEET 2 OF 5                                                                      |                                                        | SYSTEM                                                                                                                                                                                                  |                                  | ITEM : INSTRUMENTATION CABLES                                                      |                                                    |                                                                                                                                           | SECTION                                                                                                                                   |                                                                              | VOLUME III                             |                            |                                  |   |                                                                  |
| SL. NO.                                                                           | COMPONENT/OPERATION                                    | CHARACTERISTICS CHECK                                                                                                                                                                                   | CAT.                             | TYPE/ METHOD OF CHECK                                                              | EXTENT OF CHECK                                    | REFERENCE DOCUMENT                                                                                                                        | ACCEPTANCE NORM                                                                                                                           | FORMAT OF RECORD                                                             | AGENCY                                 | P                          | W                                | V | REMARKS                                                          |
| 1                                                                                 | 2                                                      | 3                                                                                                                                                                                                       | 4                                | 5                                                                                  | 6                                                  | 7                                                                                                                                         | 8                                                                                                                                         | 9                                                                            | 10                                     |                            |                                  |   | 11                                                               |
| 1.4                                                                               | Fillers (as applicable)                                | 1. Type<br>2. Flame retardant & moisture resistant (as applicable)                                                                                                                                      | MA<br>CR                         | Verify<br>Chemical/ Environ.                                                       | -do-<br>-do-                                       | Approved datasheet<br>-do-                                                                                                                | Approved datasheet<br>-do-                                                                                                                | -do-<br>-do-                                                                 | 3/2<br>3/2                             | -<br>-                     | 1<br>2                           |   |                                                                  |
| 1.5                                                                               | Galvanised steel wire/strip for Armour (if applicable) | <b>GENERAL :</b><br>1. Make<br><br>2. Dimension<br>3. Phy.and Elec. Properties<br>3.Galvanization Quality                                                                                               | MA<br>MA<br>MA<br>MA             | Verify<br>Measurement<br>Physical & Electrical Tests<br>Galv.Tests                 | Manufacturer std.<br>-do-<br>Sample*<br>-do-       | Manufacturer approved source<br>-do-<br>Relevant Standard/ Appd. Data Sheet/<br>-do-                                                      | Manufacturer approved source<br>-do-<br>Relevant Standard/ Appd. Data Sheet/<br>-do-                                                      | Log book/ Test Cert.<br>-do-<br>-do-<br>-do-                                 | 3/2<br>3/2<br>3/2<br>3/2               | -<br>-<br>-<br>-           | 1<br>2<br>2<br>2                 |   | * Sample from each size/ Batch/Lot.                              |
| 1.6                                                                               | PVC compound for Sheath                                | <b>GENERAL :</b><br>1. Physical properties<br>2. Elec.Properties<br>3. FRLS Properties (as applicable)<br><br><b>SPECIFIC CHECKS :</b><br>a) Make<br>b) Type/ Grade<br>c) Shelf life/ Storage condition | MA<br>MA<br>CR<br>MA<br>MA<br>MA | Physical Tests<br>Electrical Tests<br>Chemical/ Environ.<br>Verify<br>-do-<br>-do- | Sample<br>Sample<br>Sample<br>100%<br>-do-<br>-do- | Relevant Standard/ Approved datasheet<br>-do-<br>-do-<br>Manufacturer approved source<br>Approved datasheet<br>Compound Manufacturer std. | Relevant Standard/ Approved datasheet<br>-do-<br>-do-<br>Manufacturer approved source<br>Approved datasheet<br>Compound Manufacturer std. | Log book/ Test Cert.<br>-do-<br>-do-<br>Log book/ Test Cert.<br>-do-<br>-do- | 3/2<br>3/2<br>3/2<br>3/2<br>3/2<br>3/2 | -<br>-<br>-<br>-<br>-<br>- | 1/2<br>1/2<br>1/2<br>1<br>1<br>1 |   |                                                                  |
| 1.7                                                                               | Wooden drums                                           | 1. Phy. & Constructional checks<br>2. Anti termite treatment                                                                                                                                            | MA<br>MA                         | Visual<br>Chem.                                                                    | Mfr's Plant Std.<br>Mfr's Plant Std.               | IS 10418<br>Mfr's Plant Std.                                                                                                              | IS 10418<br>Mfr's Plant Std.                                                                                                              | Log book/ Test Cert.<br>COC                                                  | 3/2<br>3/2                             | -<br>-                     | 1<br>1                           |   |                                                                  |
| 1.8                                                                               | Steel drums                                            | 1. Dimension<br>2. Surface finish                                                                                                                                                                       | MA<br>MA                         | Meas.<br>Meas.                                                                     | Mfr's Plant Std.<br>-do-                           | Mfr's Plant Std.<br>-do-                                                                                                                  | Mfr's Plant Std.<br>-do-                                                                                                                  | Log book/ Test Cert.<br>-do-                                                 | 3/2<br>3/2                             | -<br>-                     | 1<br>1                           |   |                                                                  |
| 2.0                                                                               | IN PROCESS                                             |                                                                                                                                                                                                         |                                  |                                                                                    |                                                    |                                                                                                                                           |                                                                                                                                           |                                                                              |                                        |                            |                                  |   |                                                                  |
| 2.1                                                                               | Wire Drawing & Annealing.                              | 1. Size<br>2. Surface finish<br>3. % of Elongation                                                                                                                                                      | MA<br>MA<br>MA                   | Dimensional<br>Visual<br>Mechanical                                                | Plant Mfg. Std.<br>-do-<br>-do-                    | Approved datasheet<br>Surface shall be smooth<br>IS 8130                                                                                  | Approved datasheet<br>Surface shall be smooth<br>IS 8130                                                                                  | Log Book                                                                     | 2                                      | -                          | 1                                |   |                                                                  |
| 2.2                                                                               | Tinning (Conductor or drain wire)                      | 1. Size<br><br>2. % of Elongation                                                                                                                                                                       | MA<br>MA                         | Dimensional<br>Mechanical                                                          | Plant Mfg. Std.<br>-do-                            | Approved datasheet<br>IS 8130                                                                                                             | Approved datasheet<br>IS 8130                                                                                                             | Log Book                                                                     | 2                                      | -                          | 1                                |   | (Applicable only for tin-coated copper conductor and drain wire) |
| 2.3                                                                               | Stranding of wires                                     | 1. No.of wires                                                                                                                                                                                          | MA                               | Counting                                                                           | Plant Mfg. Std.                                    | IS 8130/<br>Appd. Data Sheet                                                                                                              | IS 8130/<br>Appd. Data Sheet                                                                                                              | -do-                                                                         | 2                                      | -                          | -                                |   |                                                                  |
|                                                                                   |                                                        |                                                                                                                                                                                                         | <b>PARTICULARS</b>               |                                                                                    | <b>BIDDER/VENDOR</b>                               |                                                                                                                                           |                                                                                                                                           |                                                                              |                                        |                            |                                  |   |                                                                  |
| BHEL                                                                              |                                                        |                                                                                                                                                                                                         | NAME                             |                                                                                    |                                                    |                                                                                                                                           |                                                                                                                                           |                                                                              |                                        |                            |                                  |   |                                                                  |
|                                                                                   |                                                        |                                                                                                                                                                                                         | SIGNATURE                        |                                                                                    |                                                    |                                                                                                                                           |                                                                                                                                           |                                                                              |                                        |                            |                                  |   |                                                                  |
|                                                                                   |                                                        |                                                                                                                                                                                                         | DATE                             |                                                                                    |                                                    |                                                                                                                                           |                                                                                                                                           | BIDDER'S/VENDORS COMPANY SEAL                                                |                                        |                            |                                  |   |                                                                  |

|                                                                                   |                                                               |                                                 |                       |              |                               |                                            |                                                            |                                                    |                               |           |                             |                                                             |         |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------|-----------------------|--------------|-------------------------------|--------------------------------------------|------------------------------------------------------------|----------------------------------------------------|-------------------------------|-----------|-----------------------------|-------------------------------------------------------------|---------|
|  |                                                               | <b>QUALITY PLAN</b>                             |                       |              | CUSTOMER : OPGCL              |                                            |                                                            | PROJECT : 2X660 MW IB TPS                          |                               |           | SPECIFICATION               |                                                             |         |
|                                                                                   |                                                               |                                                 |                       |              | BIDDER/ VENDOR :              |                                            |                                                            | TITLE                                              |                               |           | NUMBER : PE-TS-391-507-E004 |                                                             |         |
|                                                                                   |                                                               |                                                 |                       |              | SYSTEM                        |                                            |                                                            | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E004, REV 0. |                               |           | SPECIFICATION :<br>TITLE    |                                                             |         |
| SHEET 3 OF 5                                                                      |                                                               |                                                 |                       |              | ITEM : INSTRUMENTATION CABLES |                                            |                                                            | SECTION                                            |                               |           | VOLUME III                  |                                                             |         |
| SL. NO.                                                                           | COMPONENT/OPERATION                                           |                                                 | CHARACTERISTICS CHECK | CAT.         | TYPE/ METHOD OF CHECK         | EXTENT OF CHECK                            | REFERENCE DOCUMENT                                         | ACCEPTANCE NORM                                    | FORMAT OF RECORD              | AGENCY    |                             |                                                             | REMARKS |
|                                                                                   |                                                               |                                                 |                       |              |                               |                                            |                                                            |                                                    |                               | P         | W                           | V                                                           |         |
| <b>1</b>                                                                          | <b>2</b>                                                      |                                                 | <b>3</b>              | <b>4</b>     | <b>5</b>                      | <b>6</b>                                   | <b>7</b>                                                   | <b>8</b>                                           | <b>9</b>                      | <b>10</b> |                             | <b>11</b>                                                   |         |
| 2.4                                                                               | Core Insulation<br>(No repair permitted)                      | 2. Resistance                                   | CR                    | Electrical   | -do-                          | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | -                           | # To be checked at starting & finish end of Extruded Length |         |
|                                                                                   |                                                               | 3. Sequence, lay length & Direction             | MA                    | Visual, Meas | Sample                        | BHEL'S/ Vendor's Spec./ Approved datasheet | BHEL'S/ Vendor's Spec./ Approved datasheet                 | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 4. Surface Finish                               | MA                    | Visual       | Sample                        | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 5.Dimension                                     | MA                    | Measurement  | Sample                        | Appd. Data Sheet                           | Appd. Data Sheet                                           | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 1. Surface finish                               | MA                    | Visual       | 100%                          | -                                          | Free from bulging burnt particles lumps, cuts & Scratches. | -do-                                               | 2                             | -         | 1                           |                                                             |         |
|                                                                                   |                                                               | 2 Insulation thickness (Min./ Max.)             | CR                    | Measurement  | Sample                        | Appd.data sheet/ Relevant Std.             | Appd.data sheet/ Relevant Std.                             | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 3. Concentricity #                              | CR                    | Measurement  | Sample                        | Mfr's Std./Appd. data sheet                | Mfr's Std./Appd. data sheet                                | Log Book                                           | 2                             | -         | 1                           |                                                             |         |
|                                                                                   |                                                               | 4 Dia over insulation                           | MA                    | Measurement  | Sample                        | Relevant Standard/ Appd. Data Sheet        | Relevant Standard/ Appd. Data Sheet                        | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 5. Core identification                          | MA                    | Visual       | 100%                          | Relevant Standard/ Appd. Data Sheet        | Relevant Standard/ Appd. Data Sheet                        | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 6. TS & % Elongation                            | MA                    | Mechanical   | 100%                          | Relevant Standard/ Appd. Data Sheet        | Relevant Standard/ Appd. Data Sheet                        | -do-                                               | 2                             | -         | -                           |                                                             |         |
| 2.5                                                                               | Core pairing, screening<br>(provision of drain wire & laying) | 1. Pair identification                          | MA                    | Visual       | 100%                          | Relevant Standard/ Appd. Data Sheet        | Relevant Standard/ Appd. Data Sheet                        | Log Book                                           | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 2.Wire size & tape size                         | MA                    | Measurement  | 100%                          | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 3.Test for capacitance                          | CR                    | Elect. Test  | 100%                          | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | 1                           |                                                             |         |
|                                                                                   |                                                               | 4. Sequence of lay and lay length               | MA                    | Visual meas  | Sample                        | Appd. Data Sheet & MFRs. Std.              | Appd. Data Sheet & MFRs. Std.                              | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 5. Screen overlap & coverage                    | MA                    | Measurement  | Sample                        | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 6. Dia over laid up core                        | MA                    | Measurement  | -do-                          | -do-                                       | -do-                                                       | -do-                                               | 2                             | -         | -                           |                                                             |         |
|                                                                                   |                                                               | 7. Continuity of drain & drain wire with Screen | MA                    | Elect. Test  | 100%                          | <-----No Discontinuity ----->              | -do-                                                       | 2                                                  | -                             | -         |                             |                                                             |         |
|                                                                                   |                                                               |                                                 |                       |              |                               |                                            |                                                            |                                                    |                               |           |                             |                                                             |         |
|                                                                                   |                                                               |                                                 | <b>PARTICULARS</b>    |              |                               | <b>BIDDER/VENDOR</b>                       |                                                            |                                                    |                               |           |                             |                                                             |         |
| <b>BHEL</b>                                                                       |                                                               |                                                 | <b>NAME</b>           |              |                               |                                            |                                                            |                                                    |                               |           |                             |                                                             |         |
|                                                                                   |                                                               |                                                 | <b>SIGNATURE</b>      |              |                               |                                            |                                                            |                                                    |                               |           |                             |                                                             |         |
|                                                                                   |                                                               |                                                 | <b>DATE</b>           |              |                               |                                            |                                                            |                                                    | BIDDER'S/VENDORS COMPANY SEAL |           |                             |                                                             |         |

|                                                                                   |                                        |                          |                     |                       |                             |                                                    |                                                            |                  |                                      |   |   |           |
|-----------------------------------------------------------------------------------|----------------------------------------|--------------------------|---------------------|-----------------------|-----------------------------|----------------------------------------------------|------------------------------------------------------------|------------------|--------------------------------------|---|---|-----------|
|  | <b>QUALITY PLAN</b>                    |                          | CUSTOMER : OPGCL    |                       |                             | PROJECT : 2X660 MW IB TPS                          |                                                            |                  | SPECIFICATION                        |   |   |           |
|                                                                                   |                                        |                          | BIDDER/ :<br>VENDOR |                       |                             | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E004, REV 0. |                                                            |                  | NUMBER : PE-TS-391-507-E004          |   |   |           |
|                                                                                   | SHEET 4 OF 5                           |                          | SYSTEM              |                       |                             | ITEM : INSTRUMENTATION CABLES                      |                                                            |                  | SPECIFICATION :<br>TITLE             |   |   |           |
| SL. NO.                                                                           | COMPONENT/OPERATION                    | CHARACTERISTICS CHECK    | CAT.                | TYPE/ METHOD OF CHECK | EXTENT OF CHECK             | REFERENCE DOCUMENT                                 | ACCEPTANCE NORM                                            | FORMAT OF RECORD | SECTION VOLUME III                   |   |   |           |
|                                                                                   |                                        |                          |                     |                       |                             |                                                    |                                                            |                  | P                                    | W | V | REMARKS   |
| <b>1</b>                                                                          | <b>2</b>                               | <b>3</b>                 | <b>4</b>            | <b>5</b>              | <b>6</b>                    | <b>7</b>                                           | <b>8</b>                                                   | <b>9</b>         | <b>10</b>                            |   |   | <b>11</b> |
| 2.6                                                                               | Inner Sheath Extrusion (if applicable) | 1. Surface finish        | MA                  | Visual                | 100%                        | --                                                 | Free from bulging, burnt particles,lumps cuts & scratches. | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 2. Sheath thickness      | MA                  | Measurement           | Sample                      |                                                    |                                                            | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 3.Dia over inner sheath  | MA                  | Measurement           | Sample                      | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 4. Colour                | MA                  | Visual                | 100%                        | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | -do-             | 2                                    | - | - |           |
| 2.7                                                                               | Armouring ( If Applicable)             | 1. No.of wires/Strips    | MA                  | Counting              | At the start of the process | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 2. Size of wire/ Strip   | MA                  | Measurement           | -do-                        | -do-                                               | -do-                                                       | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 3. Lay Direction         | MA                  | Visual                | -do-                        | -do-                                               | -do-                                                       | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 4. Lay Length            | MA                  | Visual, Meas.         | At the start of the process | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | Log Book         | 2                                    | - | - |           |
|                                                                                   |                                        | 5. Coverage              | MA                  | Measurement           | -do-                        | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        | 6. Dia over armouring    | MA                  | Measurement           | -do-                        | -do-                                               | -do-                                                       | -do-             | 2                                    | - | - |           |
| 2.8                                                                               | Outer Sheath Extrusion                 | 1. Surface Finish        | MA                  | Visual                | 100%                        | -                                                  | Free from Bulging Burnt particles, lumps, cuts & scratches | Log Book         | 2                                    | - | - |           |
|                                                                                   |                                        | 2.Sheath thickness       | MA                  | Measurement           | Sample                      | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | Log Book         | 2                                    | - | - |           |
|                                                                                   |                                        | 3. Dia over outer sheath | MA                  | Measurement           | Sample                      | -do-                                               | -do-                                                       | -do-             | 2                                    | - | - |           |
|                                                                                   |                                        |                          | <b>PARTICULARS</b>  |                       |                             | <b>BIDDER/VENDOR</b>                               |                                                            |                  |                                      |   |   |           |
| <b>BHEL</b>                                                                       |                                        |                          | <b>NAME</b>         |                       |                             |                                                    |                                                            |                  |                                      |   |   |           |
|                                                                                   |                                        |                          | <b>SIGNATURE</b>    |                       |                             |                                                    |                                                            |                  |                                      |   |   |           |
|                                                                                   |                                        |                          | <b>DATE</b>         |                       |                             |                                                    |                                                            |                  | <b>BIDDER'S/VENDORS COMPANY SEAL</b> |   |   |           |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            |             |                              |                 |                                                    |                                                            |                  |                               |            |   |                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------|-------------|------------------------------|-----------------|----------------------------------------------------|------------------------------------------------------------|------------------|-------------------------------|------------|---|----------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     | <b>QUALITY PLAN</b>                        |             | CUSTOMER : OPGCL             |                 | PROJECT : 2X660 MW IB TPS                          |                                                            |                  | SPECIFICATION                 |            |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            |             | BIDDER/ :                    |                 | TITLE                                              |                                                            |                  | NUMBER : PE-TS-391-507-E004   |            |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            |             | VENDOR                       |                 | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E004, REV 0. |                                                            |                  | SPECIFICATION :               |            |   |                                              |
| SHEET 5 OF 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     | SYSTEM                                     |             | ITEM :INSTRUMENTATION CABLES |                 |                                                    | SECTION                                                    |                  |                               | VOLUME III |   |                                              |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | COMPONENT/OPERATION | CHARACTERISTICS CHECK                      | CAT.        | TYPE/ METHOD OF CHECK        | EXTENT OF CHECK | REFERENCE DOCUMENT                                 | ACCEPTANCE NORM                                            | FORMAT OF RECORD | AGENCY                        |            |   | REMARKS                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            |             |                              |                 |                                                    |                                                            |                  | P                             | W          | V |                                              |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2                   | 3                                          | 4           | 5                            | 6               | 7                                                  | 8                                                          | 9                | 10                            |            |   | 11                                           |
| 3.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Final Inspection    | 4. Marking/ Colour/ Embossing              | MA          | Visual                       | 100%            | Appd. Data Sheet                                   | Appd. Data Sheet                                           | Test Report      | 2                             | -          | - | Sequential marking shall be done by printing |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 5. TS & % Elongation                       | MA          | Mechanical                   | 100%            | Relevant Standard/ Appd. Data Sheet                | Relevant Standard/ Appd. Data Sheet                        | -do-             | 2                             | -          |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 1. Finish & Length                         | MA          | Visual                       | (See remark)    | Relevant Standard/ Appd. Data Sheet                | Free from Bulging Burnt particles, lumps, cuts & scratches | Test Report      | 2                             | 1          | - | One drum in a Lot                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 2. Dimensions                              | MA          | Measurement                  | Sample Lengths  | Appd. Data sheet                                   | Appd. Data sheet                                           | Test Report      | 2                             | 1          | - |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 3. Armouring - Coverage No.of Wires/Strips | MA          | Visual & Meas.               | Sample          | -do-                                               | -do-                                                       | -do-             | 2                             | 1          | - |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 4. Marking/Colour/ pair identification     | MA          | Visual                       | -do-            | -do-                                               | -do-                                                       | -do-             | 2                             | 1          | - |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 5. Test for screening                      | CR          | Elect. Test                  | -do-            | -do-                                               | -do-                                                       | -do-             | 2                             | 1          | - |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 6. Acceptance Tests                        | CR          | Phy & Elect. Tests           | sample          | -do-                                               | -do-                                                       | -do-             | 2                             | 1          |   | Refer Annexure to QAP for sampling plan.     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     | 7. Type & FRLS Tests                       | CR          | Measurement                  | Sample#         | Appd. Data sheet                                   | Appd. Data sheet                                           | -do-             | 2                             | 1          | - | Refer Annexure to QAP for sampling plan.     |
| <p>NOTES:-</p> <p>(A) JOINTS IN WIRE SHALL BE AS PERMITTED BY REL STD / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME.</p> <p>(B) NO REPAIR OF CORE INSULATION PERMITTED.</p> <p>(C) CABLE ENDS SHALL BE SEALED AS PER REL. STD./ BHEL SPECIFICATION</p> <p>(D) RECORD OF RAW MATERIAL, PROCESS &amp; ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.</p> <p>(E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION</p> <p>(F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER.</p> <p>(G) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER REL. STD./ BHEL SPECIFICATION.</p> <p>(H) FOR LIST OF TYPE TESTS, ROUTINE TESTS &amp; ACCEPTANCE TESTS; REFER ANNEXURE TO QAP.</p> <p>LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3 SUB VENDOR CHP: CUSTOMER HOLD POINT</p> <p>TC : Test Certificates, Spec. : Specification Mfg. : Manufacturer.</p> |                     |                                            |             |                              |                 |                                                    |                                                            |                  |                               |            |   |                                              |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                            | PARTICULARS |                              |                 | BIDDER/VENDOR                                      |                                                            |                  |                               |            |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            | NAME        |                              |                 |                                                    |                                                            |                  |                               |            |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            | SIGNATURE   |                              |                 |                                                    |                                                            |                  |                               |            |   |                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                            | DATE        |                              |                 |                                                    |                                                            |                  | BIDDER'S/VENDORS COMPANY SEAL |            |   |                                              |

|                                                                                  |                 |                 |                                              |                                          |
|----------------------------------------------------------------------------------|-----------------|-----------------|----------------------------------------------|------------------------------------------|
|  | ANNEXURE TO QAP | CUSTOMER: OPGCL | PROJECT TITLE: 2X660 MW IB VALLEY TPS        | SPECIFICATION NUMBER: PE-TS-391-507-E004 |
|                                                                                  |                 | BIDDER/VENDOR:  | QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0 | SPECIFICATION TITLE:                     |
|                                                                                  | SHEET           | SYSTEM          | ITEM: SCREENED CONTROL CABLES (AS PER VDE)   | DOC. NO.                                 |

## TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS (AS PER VDE)

### A. Type Test Conduction:

- Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.
- Sampling:
  - Type test to be conducted on one size of each type/ lot.
  - FRLS test & Electrical tests to be conducted on every size & type of cables.
  - Flammability Test to be conducted only on one sample/ lot.

### B. Acceptance Test Conduction:

- Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.
- Sampling:
  - Sampling for acceptance tests shall be as per Appendix-B (Clause 15.2.2) of IS: 1554 Part-I.
  - FRLS test & Electrical tests to be conducted on every size & type of cables.
  - Flammability Test to be conducted only on one sample/ lot.

### C. Routine Test Conduction:

- Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

**D. C&I Tests listed in S.No-9.0 shall be conducted only one size/ type / lot.**

**E. ADS: Approved datasheet.**

| S. No. | TEST                                 | APPLICABLE FOR                                | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS                                                                    |
|--------|--------------------------------------|-----------------------------------------------|-----------------------------|--------------------|----------------------------------------------------------------------------|
| 1.0    | Tests for Conductor                  |                                               |                             |                    |                                                                            |
| I.     | Annealing test                       | For copper conductor only                     | T, A                        | IS 10810 Pt 1      | <i>Internal in process Test Report to be furnished for acceptance test</i> |
| II.    | Tin coating test (for tinned copper) | For copper conductor only                     | T, A                        | IS 10810 Pt 4      |                                                                            |
| III.   | Resistance test                      | For Al/Cu                                     | T, A, R                     | VDE 0815           |                                                                            |
| IV.    | Diameter test                        | For conductor                                 | T, A                        | ADS/ IS 10810      |                                                                            |
|        |                                      |                                               |                             |                    |                                                                            |
| 2.0    | Tests for Armour Wires/Strips        |                                               |                             |                    |                                                                            |
| I.     | Measurement of dimensions            | Applicable for Aluminium wire & GS wire/Strip | T,A                         | IS 10810 Pt 36     |                                                                            |

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| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
|      | SIGNATURE   |                |                                 |
|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

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|  | <b>ANNEXURE TO QAP</b> | CUSTOMER: OPGCL | PROJECT TITLE: 2X660 MW IB VALLEY TPS        | SPECIFICATION NUMBER: PE-TS-391-507-E004 |
|                                                                                  |                        | BIDDER/VENDOR:  | QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0 | SPECIFICATION TITLE:                     |
|                                                                                  | SHEET                  | SYSTEM          | ITEM: SCREENED CONTROL CABLES (AS PER VDE)   | DOC. NO.                                 |

| S. No.     | TEST                                                      | APPLICABLE FOR                                                     | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS |
|------------|-----------------------------------------------------------|--------------------------------------------------------------------|-----------------------------|--------------------|---------|
| II.        | Tensile test                                              | Applicable for Aluminium wire & GS wire/Strip                      | T, A                        | IS 10810 Pt 37     |         |
| III.       | Elongation at break test                                  | Applicable for GS wire/Strip only                                  | T, A                        | IS 10810 Pt 37     |         |
| IV.        | Torsion test                                              | For GS round wire only                                             | T, A                        | IS 10810 Pt 38     |         |
| V.         | Winding test                                              | For GS strip only                                                  | T, A                        | IS 10810 Pt 39     |         |
| VI.        | Resistivity test                                          | Applicable for Aluminium wire & GS wire                            | A                           | IS 10810 Pt 42     |         |
| VII.       | Uniformity of Zinc coating test                           | For G. S. wires/Strip only                                         | A                           | IS 10810 Pt 40     |         |
| VIII.      | Mass of Zinc coating test                                 | For G. S. wires/Strip only                                         | A                           | IS 10810 Pt 41     |         |
| IX.        | Wrapping Test                                             | For Aluminium wires only                                           | A                           | IS 10810 Pt 3      |         |
| <b>3.0</b> | <b>Physical Tests for PVC Insulation &amp; PVC sheath</b> |                                                                    |                             |                    |         |
| I.         | Test for thickness & Eccentricity                         | Applicable for PVC insulation, PVC inner sheath & PVC outer sheath | T, A                        | VDE 0472           |         |
| II.        | Tensile strength and elongation test at break             | Applicable for PVC insulation & PVC outer sheath                   | T, A                        | VDE 0472           |         |
| (a)        | Before ageing                                             |                                                                    | T, A                        |                    |         |
| (b)        | After ageing                                              |                                                                    | T, A                        |                    |         |
| III.       | Ageing in air oven                                        | Applicable for PVC insulation & PVC outer sheath                   | T                           | VDE 0472           |         |
| IV.        | Loss of mass in air oven test                             | For PVC Insulation, PVC Inner & outer sheath.                      | T                           | VDE 0472           |         |
| V.         | Hot deformation test                                      | For PVC Insulation, PVC Inner & outer sheath.                      | T                           | VDE 0472           |         |
| VI.        | Heat shock test                                           | For PVC Insulation, PVC Inner & outer sheath.                      | T                           | VDE 0472           |         |
| VII.       | Shrinkage test                                            | For PVC insulation, PVC inner & PVC outer sheath.                  | T                           | VDE 0472           |         |
| VIII.      | Thermal stability test                                    | For PVC outer sheath only                                          | T                           | VDE 207            |         |
| IX.        | Hot set test                                              | For PVC insulation only                                            | T, A                        | IS 10810 Pt 30     |         |
| X.         | Bleeding & Blooming test                                  | For PVC Insulation, PVC Inner & outer sheath.                      | T                           | IS 10810 Pt 19     |         |
| XI.        | Cold bend & Cold impact test                              | For PVC Inner & outer sheath.                                      | T                           | VDE 0472/ IS 5831  |         |
| XII.       | Colour Fastness to water                                  | For PVC Outer sheath only.                                         | T                           | IS 5831            |         |
|            |                                                           |                                                                    |                             |                    |         |
| <b>4.0</b> | <b>Tests for Al-Mylar Shield</b>                          |                                                                    |                             |                    |         |
| I.         | Continuity test                                           | For Al-Mylar shield                                                | T, A                        | Plant Standard     |         |
| II.        | Shield thickness                                          | For Al-Mylar shield                                                | A                           | ADS                |         |
| III        | Overlap test                                              | For Al-Mylar shield                                                | A                           | ADS                |         |

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|------|-------------|----------------|---------------------------------|
| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
|      | SIGNATURE   |                |                                 |
|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

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|  | ANNEXURE TO QAP | CUSTOMER: OPGCL | PROJECT TITLE: 2X660 MW IB VALLEY TPS        | SPECIFICATION NUMBER: PE-TS-391-507-E004 |
|                                                                                  |                 | BIDDER/VENDOR:  | QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0 | SPECIFICATION TITLE:                     |
|                                                                                  | SHEET           | SYSTEM          | ITEM: SCREENED CONTROL CABLES (AS PER VDE)   | DOC. NO.                                 |

| S. No.     | TEST                                                   | APPLICABLE FOR                  | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD         | REMARKS                                                                    |
|------------|--------------------------------------------------------|---------------------------------|-----------------------------|----------------------------|----------------------------------------------------------------------------|
| IV         | Constructional details,                                | For Al-Mylar shield             | A                           | ADS                        |                                                                            |
| V          | Visual, surface finish+                                | For Al-Mylar shield             | A                           | Plant Standard             |                                                                            |
| VI         | Overall coverage                                       | For Al-Mylar shield             | A                           | Plant Standard             |                                                                            |
| VII        | Noise interference test.                               | For Al-Mylar shield             | A                           | ADS                        |                                                                            |
|            |                                                        |                                 |                             |                            |                                                                            |
| <b>5.0</b> | <b>Tests for Drain Wire</b>                            |                                 |                             |                            |                                                                            |
| I.         | Annealing test                                         | For copper conductor only       | T, A                        | IS 10810 Pt 1              | <i>Internal in process Test Report to be furnished for acceptance test</i> |
| II.        | Tin coating test (for tinned copper)                   | For copper conductor only       | T, A                        | IS 10810 Pt 4              |                                                                            |
| III.       | Resistance test                                        | For Al/Cu                       | T, A, R                     | VDE 0815                   |                                                                            |
| IV.        | Diameter test                                          | For conductor                   | T, A                        | ADS                        |                                                                            |
| V.         | Drain wire continuity test                             | For conductor                   | T, A                        | Plant Standard             |                                                                            |
|            |                                                        |                                 |                             |                            |                                                                            |
| <b>6.0</b> | <b>FRLS Tests</b>                                      |                                 |                             |                            |                                                                            |
| I.         | Oxygen index test                                      | For PVC outer sheath & Fillers. | T, A                        | ASTMD 2863                 | <i>Applicable for Inner Sheath if the same is indicated in Datasheet-A</i> |
| II.        | Smoke density test                                     | For PVC outer sheath.           | T, A                        | ASTMD 2843                 |                                                                            |
| III.       | Acid gas generation test                               | For PVC outer sheath.           | T, A                        | IEC-754-1                  |                                                                            |
| IV.        | Temperature Index Test                                 | For PVC outer sheath & Fillers. | T                           | ASTMD 2863                 |                                                                            |
|            |                                                        |                                 |                             |                            |                                                                            |
| <b>7.0</b> | <b>Flammability Tests</b>                              |                                 |                             |                            |                                                                            |
| I.         | Flammability test for single cable                     | For complete cable              | T,A                         | IEC:60332 Part-1           | <i>Test &amp; Category applicable as indicated in Datasheet-A</i>          |
| II.        | Flammability test for bunched cable                    | For complete cable              | A                           | IEC:60332 Part-3, CAT-B    |                                                                            |
| III.       | Swedish chimney test                                   | For complete cable              | A                           | SEN SS 424 1475 (Class F3) |                                                                            |
| IV.        | Flammability test                                      | For complete cable              | A                           | IEEE: 383                  |                                                                            |
|            |                                                        |                                 |                             |                            |                                                                            |
| <b>8.0</b> | <b>Electrical Tests</b>                                |                                 |                             |                            |                                                                            |
| I.         | High Voltage Test                                      | For complete cable              | T, A, R                     | VDE 0815                   |                                                                            |
| II.        | Insulation Resistance Test (Volume resistivity method) | For complete cable              | T, A                        | IS 10810 Pt 43             |                                                                            |
| III.       | Thermal ageing test                                    | For complete cable              | T                           | IS 1554-I                  |                                                                            |
|            |                                                        |                                 |                             |                            |                                                                            |

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| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
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|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

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|----------------------------------------------------------------------------------|-----------------|-----------------|----------------------------------------------|---------------------------------------------|
|  | ANNEXURE TO QAP | CUSTOMER: OPGCL | PROJECT TITLE: 2X660 MW IB VALLEY TPS        | SPECIFICATION<br>NUMBER: PE-TS-391-507-E004 |
|                                                                                  |                 | BIDDER/VENDOR:  | QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0 | SPECIFICATION<br>TITLE:                     |
|                                                                                  | SHEET           | SYSTEM          | ITEM: SCREENED CONTROL CABLES (AS PER VDE)   | DOC. NO.                                    |

| S. No. | TEST                                      | APPLICABLE FOR            | TEST<br>CONDUCTION<br>REQUIRED AS | REFERENCE<br>STANDARD | REMARKS                                                        |
|--------|-------------------------------------------|---------------------------|-----------------------------------|-----------------------|----------------------------------------------------------------|
| 9.0    | C&I Tests                                 |                           |                                   |                       |                                                                |
| I.     | Cross talk                                | For complete cable        | T, A                              | ADS                   |                                                                |
| II.    | Attenuation                               | For complete cable        | T, A                              | ADS                   |                                                                |
| III.   | Characteristic Impedance                  | For complete cable        | T, A                              | ADS                   |                                                                |
| IV.    | Mutual capacitance                        | For complete cable        | T, A                              | ADS                   |                                                                |
| V.     | Noise interference                        | For complete cable        | T, A                              | ADS                   |                                                                |
|        |                                           |                           |                                   |                       |                                                                |
| 10.0   | Anti-rodent and Termite<br>Repulsion test | For PVC outer sheath only | A                                 | ADS                   | <b>Test<br/>applicable as<br/>indicated in<br/>Datasheet-A</b> |
| 11.0   | Dimensional checks                        | For complete cable        | T, A                              | ADS & IS 10810        |                                                                |

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|------|-------------|----------------|---------------------------------|
| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
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|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |